

DIABETIC FOOT: CHRONIC WOUND TREATMENT MANAGEMENT, CASE REPORT AND LITERATURE REVIEW

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Abstract

Diabetic foot still represents a challenge for health care systems around the globe, as a consequence of chronic evolution of foot ulcers, because of the complication of these lesions and the increased number of amputations. Pecoraro's study shows that 84% of amputations were preceded by a foot ulcer history. By pointing out and correcting the risk factors, and adopting the appropriate treatment we can interrupt the pathway to ulceration. Reducing the number of amputation by 50% is an important goal pointed out by the St. Vincent declaration. So, the complex treatment of foot ulcers and further more of necrotic purulent lesions can create the premises to avoid major amputation and can be live saving, findings shown in the case report presented bellow.

Key words: Diabetes mellitus, foot ulcer, negative pressure wound therapy, limb amputation.

INTRODUCTION

Peripheral vascular disease together with neuropathies are some of the most important causes of chronic foot ulcers, chronic pain syndrome and eventually amputations. The term of diabetic foot imposed as a necessity to assure the possibility of systematizing etiopathogeny and a proper therapeutic approach of these wounds. Diabetic foot is a concept that allows correlations between different intrinsic etiopathogenic factors (chronic arterial disease, neuropathy, leg deformity) and the extrinsic factors (minor leg trauma) whose interaction leads to tissue loss (ulceration), wounds that needs conservative or major leg amputations due to the bacterial colonization and infection. Diabetic foot ulcer (DFU) represents one of the most common complication in the evolution of diabetes mellitus, 15% to 25% of the patients develop such a wound during their lives (Singh N., Armstrong D. G., Lipsky B. A., 2005). In present time, the risk of developing a foot ulcer or the necessity of amputation became bigger that of blindness due to diabetic retinopathy or developing chronic kidney disease (Veresiu I. A., 2005).

MATERIAL AND METHODS.

Ulcer prevalence in patients with diabetes mellitus is between 4 and 10%, with an annual incidence between 1 and 3.6% (Singh N., Armstrong

D. G., Lipsky B. A., 2005). The statistic data vary on a relatively high interval, showing us that is the result of studies which have used different methods, being conducted in specialized centers or in the community and used different definition of ulcerations. In a cross-sectional study made in different centers in Romania, 402 patients were examined; it revealed a foot ulcer prevalence of 3.2% in patients with type I diabetes mellitus and 9.7% in those with type II. In the same study, 7.9% of patients with type I diabetes and 9.7% of those with type II mentioned at least one episode of foot ulceration in history (Serban V., 2011).

Most of the foot ulcers appear at the level of fingers, both on the front and back side, at the metatarsal and the calcaneus area, due to abnormal pressure combined with foot deformities and reduction of joint mobility (LeMaster J. W., Reiber G., 2006, Boulton A. J. M., 1994).

Studies published over the time showed certain involvement of some factors (neuropathy, chronic obliterating arteriopathy and bone deformities) in the pathogenesis of chronic wounds in patients with diabetes mellitus, but they also proved that these cannot play the role of sufficient factors in the development of ulceration (Boulton A. J. M., 1994). That is why, the concept of “concurrent factors” was adopted, concept introduced in epidemiology by Rothman (cit.de Boulton A.J.M.) in 1986. According to this concept, the pathway to ulceration requires the presence of at least two of the factors listed above, as well as the involvement of so called minor factors, for example the habitual trauma. The concept introduced by Rothman has practical implications for value, firstly draws attention to underestimated factors such as minor trauma and bone deformities, and secondly it makes logical the assertion according to which eliminating one of the causes may stop de progression towards DFU.

This concept is supported by multiple clinical trials, for example Pecoraro et. all in a prospective study, followed the evolution of a group of patients with diabetes mellitus, noting the coexistence in the same patient of neuropathy, minor foot trauma, appearance of DFU, delayed healing leading to extensive tissue loss, gangrene and eventually amputation. Eliminating any of these factors can interrupt the pathogenic chain. Pecoraro’s study revealed that 84% of the amputations were preceded by the appearance of DFU. It also pointed out that peripheral ischemia is a component of the pathway to amputation in 46% of the cases, but it plays the role of sufficient cause in only 5% of the cases (Pecoraro R. E., Reiber G. E., Burgess E. M., 1990).

The St. Vincent declaration (1989) traced briefly a complex approach of diabetes mellitus and its many complications; one of the main objectives was to reduce the limb amputation rate for diabetic gangrene with

50%, making recommendations for reaching this goal in the next five following years (World Health Organization, 1992).

Statistics can be synthesized in the form of two rules designed to attract medical attention once more to the importance of prevention and early treatment of foot injuries. So, the rule of “15” points out that 15% of DFU lead to bone infection, 15% need amputation, the rule of “50” underlines the amputations are extensive (transtibial or transfemoral), that 50% of those who suffer a major amputation in the next 5 years suffer a second one and 50% of the patients die in the first 5 years after the first amputation (Boulton A. J. M., 1994, Wraight P.R., Lawrence S. M., Campbell D. A., et. al, 2004).

Starting from this disturbing facts, the individuality of the treatment for each patient is mandatory, as it is the multidisciplinary approach of DFU or the use of adjunctive techniques aiming chronic wound treatment (Wraight P.R., Lawrence S. M., Campbell A. D. et. al, 2004, Boyko E. J., Ahroni J. H., Smith D. G. et al., 1996). Delayed healing is one of the perpetuating factor that is responsible for the slow progress of chronic wounds in patients with diabetes mellitus. In the last decade two methods of treatment of chronic ulcers gained ground, aiming at stimulating proliferation of granulation tissue and thus promote wound healing (NPWT) (Mannari R. J., Payne W. G., Ochs D. E. et. al, 2002, Singer A. J., Clark R. A. F., 1999, Argenta L. C., Morykwas M. J., 1997). One of the methods uses moist gauze dressing, while the second one uses continuous negative pressure al the level of ulceration (Singer A. J., Clark R. A. F., 1999, Saxena V, Hwang C. W., Huang S. et al., 2004, Jeffcoate W. J., Price P., Harding K. G., 2004).

Primary surgical treatment of DFU with extensive tissue loss using split-thickness skin grafts or transposition flaps usually fails because of the local condition. That’s the reason why preparing the wound bed and providing it with appropriate granulation tissue is essential prior surgical closure (Luca Dalla Paola et al., 2010, Nakajama Y, 1990, Joseph E, Hamori C., Bergman S. et. al, 2000).

The results of these studies revealed the superiority of NPWT versus the moist gauze dressing treatment, not only from the time of going to a granular bed but also with the reduction of the wound. Also a lot of studies showed a significant decrease of bacterial colonization in the wound (Joseph E, Hamori C., Bergman S. et. al, 2000, McCallon S. K. et al., 2000, Armstrong D. G., Lavery L. A. et al., 2005). Starting from these hypotheses it was adopted comprehensive approach to a 55 years old patient, P.M. with type II diabetes mellitus who needs insulin, diagnosed 10 years ago, with a purulent necrotic foot lesion (*image 1*). We have to retain that the patient

had opposite limb knee amputation 3 years ago, the patient smokes. From the lab analyses we retain: glycemia = 483 mg/dl, HbA1c=12.3, WBC=25.500/ml, index arm/leg 0.70. The bacterial cultures from the wound emphasizes an infection with *Proteus*.



Fig. 1. The aspect of the wound purulent necrotic from the leg level, stage III B, after the classification from the Texas University with a 92% risk of amputation (Armstrong D. G., Lavery L. A., Harkless L. B., 1998).

The general physical examination reveals obesity class II with a body mass index (IMC) of 36.8 kg/m², diabetic cardiomiopathy and diabetic retinopathy. Pulse femoral and popliteal arteries present and decreased at posterior tibial artery and dorsalis pedis artery.

The therapeutic approach of this case aimed at correcting the glucose level imbalance, broad spectrum antibiotics since the time of admission that remediation infectious outbreak are opting for surgery to maintain the role of support of the limb, meaning a transmetatarsal amputation. The post-surgery evolution was initially good with the reduction of glucose level at 182 mg/dl, improving leukocytosis at 14300 ml, but at 14 days after surgery it complicated with amputation stump necrosis (*Fig.2A*), moment when it was necessary a reevaluation of the therapeutic options. The alternatives were either a higher amputation above the knee or the extensive debridement of the residual limb stump (*Fig.2B*) or the use of NPWT. We opted for the second choice in order to maintain the function of support of the leg.



Fig 2.A. Amputation stump with skin necrosis and tissue. B. After debridement of necrotic tissue stump appearance.

Local NPWT was established, following the antibiotics treatment according to antibiotic therapy. Initially I used black foam for stimulating the development of the granulation tissue, alternating with white foam for the protection of the exposed bones. The evolution was favorable with signs of improvement and more granular after the first exchange, at 8 days of NPWT, the proliferation of granulation tissue was evident. (Fig.3).



Fig. 3. The appearance of the amputation stump after 8 days fro initiating NPWT.

After 16 days of NPWT a granular bed satisfying was obtained, which allowed the achievement of a split-thickness skin graft (Fig.4A), the surgery was meant to seal the wound. The local evolution was favorable with the amputation stump on the healing process, without local signs of infection after 10 days after split-thickness skin graft. (Fig.4B)



Fig.4.A. The intra-operative appearance of the stump before split-thickness skin graft.
 B. The aspect of the stump 10 days after the plastic split.

The evolution on a long term was good without the appearance of necrotic lesions in the amputation stump in the first year after the release from the hospital, with proper epithelialization stump (*Fig.5.*) with the exception of a small area which is exposed of tarsal bones which will need minor intervention of correction but which won't affect significantly the local evolution.



Fig.5. The aspect of the leg after 1 year from the hospital release

RESULTS AND DISCUSSIONS

DFU is one of the most common and impairing complication in diabetes mellitus, and the presence of the foot ulcer is an important prognostic element for the amputation risk, shown also in Pecoraro's study. Delayed healing and bacterial colonization of the plantar ulceration can accelerate its evolution towards extended tissue necrosis leading to the necessity of limb amputation. Early treatment of the foot ulcer and by eliminating some of the pathogenic factors can represent the pathway for

reaching the goals established by the St. Vincent declaration, meaning decreasing the number of amputation by 50%.

NPWT is a efficient method for treating foot ulcer, a fact shown by many studies over the years, but it also can be used as a complementary treatment method for extensive foot lesions, creating the necessary conditions to perform a limited amputation, instead an extensive one.

As we see in the case report, NPWT created the premises for conservative surgery even facing a patient with extensive plantar lesion, listed as stage III B according to the Texas University classification, which in 92% of the patients impose an extensive amputation. An important fact that needs to be taken in consideration when analyzing this case is the reduced degree of ischemia, with pulse present at the major arteries of the limb, with a 0.7 arm/leg index, so the tissue perfusion didn't suffer considerably.

CONCLUSIONS

Purulent necrotic lesions of the foot in patients with diabetes mellitus still raises important issues regarding the surgical approach because appreciating the viability of the affected limb is essential if a conservative surgery is take in consideration. Chronic obliterated arteriopathy is a major predicting factor for the need of an extensive amputation, because is responsible for the ischemia degree of the limb. NPWT is a valuable technique in the treatment of uncomplicated foot ulcers, but it can be very useful after sharp tissue debridement when conservative surgery is taken in consideration. By reducing bacterial colonization, NPWT realizing a closed system around the wound and by stimulating tissue granulation provides a wound bed suitable for surgical closure. Maintaining the role of support of the limb, avoiding as much as possible an extensive amputation, not only improves the patient quality of life, but also improves he's life expectancy, because as we see 50% of the patients that underwent a major amputation die in the first 5 years after surgery.

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